(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 669 276 A2**

(12) EUROPEAN PATENT APPLICATION

(21) Application number: **95100767.3**

(51) Int. Cl.[6]: **B66B 11/08**

(22) Date of filing: **20.01.95**

(30) Priority: **25.02.94 JP 53201/94**

(43) Date of publication of application:
30.08.95 Bulletin 95/35

(84) Designated Contracting States:
DE FR GB

(71) Applicant: **KOYO JIDOKI Company, Ltd.**
12-1, Tsunashimahigashi 6-chome
Kohoku-ku
Yokohama-shi
Kanagawa-ken 223 (JP)

(72) Inventor: **Yamashita, Kyoichi 5-21-1,**
Tsunashima-nishi
Kohoku-ku,
Yokohama-shi
Kanagawa-ken, 223 (JP)

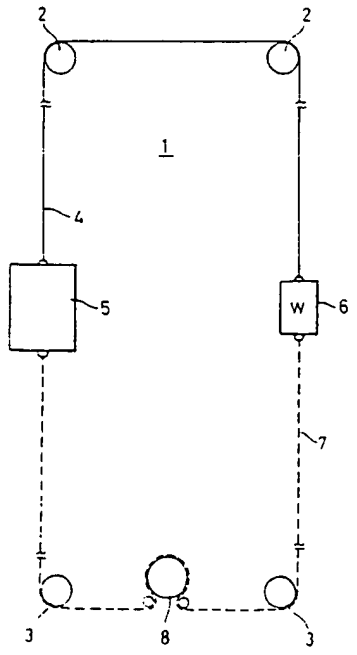
(74) Representative: **Henkel, Feiler, Hänzel & Partner**
Möhlstrasse 37
D-81675 München (DE)

(54) Elevation system.

(57) The present invention provides an elevation system to adjust a balance between a carriage and a counter weight so that a load of a driving unit can be decreased.

The carriage 5 and the counter weight 6 are suspended from a suspension cable 4, preferably a wire rope, in an elevator hall and the lower portions of the carriage and the counter weight are jointed to a lower hauling cable 7, preferably a chain, which is in cooperation with a driving unit 8 at the bottom of elevator hall for driving the hauling cable to thereby lift the carriage.

Fig. 1



EP 0 669 276 A2

BACKGROUND OF THE INVENTION:

FIELD OF THE INVENTION:

The present invention relates to an elevation system for vertically carrying passengers or freight, and particularly to an elevation system for transporting automobiles from a floor to a destination floor in a parking tower.

DESCRIPTION OF PRIOR ART

In Fig. 5 is shown an elevation system for passengers or freight. This known system is comprised of a carriage (c), wired cable (b), counter weight (d), two wheels (a) and a driving unit (e), for example, a winching machine and so on, which is located at an upper elevator hall. At one end of the cable (b) is suspended the carriage (c) and at another end is suspended the counter weight (d), said carriage and said counter weight thus being connected with each other via wheels and driving unit provided in the elevator hall. This allows the carriage (c) with boarded passengers or freight to be carried by means of the driving unit winding up and down said cable.

PROBLEMS OF THE PRIOR ART

The above described elevation system has the following disadvantages.

1. An upper location of the driving unit comprising a large scale electric motor, a device for changing speed and the winching machine requires high a rigged design of structures and a wide occupied space for the driving unit (e). A structure of the parking tower, which is to absorb vibrations from the driving unit, allows only a low efficiency of vibration prevention in spite of taking actions against occuring vibrations and noises resulting from running the driving unit (e). Particularly, the lower the weight of the construction materials used for the such parking tower, the more prominent are the demerits with respect to the vibrations.
2. Slippage between suspension cable (b), for which a wire rope is used, and wheels (a) cannot guarantee definite stoppage after going up and down.
3. In case of using a conventional elevation system for a vehicle parking system to carry automobiles, it is usually necessary in an elevation system comprising carriage and counter weight, that tied ends of the suspension cable are vertically moved. However, as said above, slippage is apt to occur between wheel and cable in case of use of a wire rope for the cable, resulting in several problems such that the carriage cannot hold horizontal or it is apt to move down to far at one end of the suspension cable. It has been considered to adopt a chain instead of the suspension cable (b). However, it is difficult to keep the stability of controlling elevation to be balanced between carriage (c) and counter weight because the self weight of the suspension cable is added to the carriage when the carriage goes down, and on the contrary, the self weight of the suspension cable is added to the counter weight when the carriage goes up.

The self weight of the suspension cable, which is added on carriage or counter weight, is not negligible with respect to adjusting balance between carriage and counter weight, and it is not only the cause of problems at the driving unit due to excessive over load, but also requires a larger sized driving source.

DETAILED DESCRIPTION OF THE INVENTION

THE OBJECT OF THE INVENTION

The object of this invention is to provide an elevation system having the following advantages:

1. It is not necessary to occupy space for a driving unit in an upper hall and to use a high efficiency antivibration system.
2. It is easy to adjust the balance between a carriage and a counter weight, and a load applied to the driving unit can be reduced.
3. It is suitable for a vehicle parking tower.

According to the invention there is provided an elevation system, comprising: a carriage hanged liftably in an elevator hall and a counter weight hanged at the opposite side of the carriage, characterized in that a suspension cable is provided around upper wheels fixed in the elevator hall and the carriage and the counter weight are hanged at each end of said cable, lower wheels are located at the bottom of the elevator hall, both ends of a lower hauling cable provided around said lower wheels are jointed to the carriage and counter weight, respectively, and one of suspension cable or lower hauling cable is jointed to a driving unit for elevating the carriage.

According to the invention there is also provided an elevation system, comprising: a carriage hanged liftably in an elevator hall and a counter weight hanged at the opposite side of the carriage, characterized in that a suspension cable, preferably a wire rope is provided around upper wheels, the carriage and the counter weight are hanged with a chain used as a lower hauling cable and extending around lower wheels located in the elevator hall, both ends of the said lower hauling cable are jointed to the carriage and the counter weight, respectively, a driving unit for applying a lifting

force to the carriage via the lower hauling cable is located at the bottom of the elevator hall.

Still further, this invention provides an elevation system, comprising a carriage liftably hanged in an elevator hall and a counter weight hanged on the opposite side of the carriage, characterized in that a suspension cable is provided around upper wheels located in the elevator hall, the carriage and the counter weight are hanged at each end of said suspension cable, a lower hauling cable is provided around lower wheels located in the elevator hall, both ends of the said lower hauling cable are jointed to carriage and the counter weight, respectively, a driving unit for applying a lifting force to the carriage via the lower hauling cable is located at the bottom of the elevator hall, and for said suspension cable and said lower hauling cable are used chains.

And further, this invention also provides an elevation system, comprising a carriage liftably hanged in an elevator hall facing a parking space in a parking tower and counter weights hanged on the opposite side of the carriage, characterised in that suspension cables, preferably wire ropes, are provided around upper wheels located on both sides of the elevator hall, the carriage and the counter weights are fixed to each end of said suspension cables, lower hauling cables, preferably chains, are provided around lower wheels located on both sides of the elevator hall, both ends of said lower hauling cables are respectively jointed to both ends of the carriage and the counter weights, a driving unit for rotatably driving both lower hauling cables is provided at the bottom portion of the elevator hall.

Effects of this invention are as follows.

1. It can ensure stable lifting control by reducing the load of the driving unit by adjusting the weight balance between left and right sides of the suspension cables only by connecting lower hauling cables with the lower portions of the carriage and the counter weight.
2. The driving unit is not loaded excessively owing to the fact that the weight of the cables between left and right portions is constantly balanced to compensate the different weight of the suspension cables between left and right portions by the lower hauling cable independent from the position of the carriage. Moreover, for determining the driving force for lifting the carriage, only the weight of the carriage has to be considered while the weight of the suspension cable can be neglected. Accordingly, the driving unit not only is improved with respect to the safety of operation and probability of deficiencies but also can be designed smaller compared to the driving units required in conventional type elevation systems.
3. By locating the driving unit at the bottom of the elevator hall instead of locating it at the upper portion of the elevator hall, there is not required particular consideration of design with respect to acchieving structural strength of the main frame of the building. In addition, it can be facilitated to deal with vibrations from the driving unit compared to locating the driving unit in the upper portion of the elevator hall.
4. It allows precise control of the carriage to hold at the stop line due to restricted slippage between the suspension cable and the upper wheels due to adopting the chain as the lower hauling cable.
5. It is very advantageous as an elevation system of a parking tower in which heavy loads are to be transported with high speed.

BRIEF DESCRIPTION OF DRAWINGS

Fig. 1 shows a schematic diagram of the elevation system of the invention.
Fig. 2 shows a situation in which a carriage is moved down.
Fig. 3 shows a situation in which the carriage is moved up.
Fig. 4 shows a drawing of a preferred embodiment in which the elevation system is employed in an automobile parking.
Fig. 5 shows a drawing of a prior art elevation system.

DESCRITPION OF THE PREFERRED EMBODIMENT

There will now be described an embodiment of the invention with reference to the drawings.

1. GENERAL STRUCTURE

Fig. 1 shows a schematic diagram of the elevation system. Upper wheels 2, 2 and lower wheels 3, 3 are located in an elevator hall 1. Suspension cables 4, for example wire ropes, are provided between and around upper wheels 2, 2 and at both ends of the cables are suspended a carriage 5 and a counter weight 6, respectively. In addition, a lower hauling cable 7, for example a chain, is provided between lower wheels 3, 3 and both ends of the lower hauling cable 7 are jointed to carriage and the counter weight, respectively, with a tension force. Suspension cable 4 and lower hauling cable 7 are forming a loop and carriage 5 and counter weight 6 are interpositioned in the symmetric position. A driving unit for lifting the carriage is located

at the bottom of the elevator hall 1. Each element of the elevation system will be described in the following.

2. CARRIAGE

Carriage 5 is not ristricted to carry passengers or luggages but may also include several devices for delivering, for example, such as devices to transport automobiles loaded thereon between parking structures in a multi floored parking tower.

Carriage 5 is equipped with mechanisms to be contacted with guide ways (not shown) located in the longitudinal directions in the elevator hall and with mechanisms to stop the system in emergency. Several other components of carriage 5 are added in accordance with the aim of transporting usage.

3. COUNTER WEIGHT

Counter weight 6 is a material sufficiently heavy to be balanced with the loaded carriage. The weight of the counter weight can be selected neglecting the different weight between left and right of the suspension cables 4 upon moving up and down the carriage 5 (or the counter weight 6), as particularly in the present invention the weight added to both ends of the suspension cables 4 is not changed without corresponding to the elevation level of carriage 5.

4. LOWER HAULING CABLE

Lower hauling cable 7, is arranged in a series with the suspension cable and is constructed of a roller-chain to compensate the different weight between left and right ends of suspension cable 2 resulting from carriage 5 being moved up and down. The lower hauling cable is contacted or in engagement with toothed lower wheels (sprockets) 3, 3 and each end thereof is respectively connected with carriage 5 and counter weight 6. Lower hauling cable 7 allows the strength of tension force to be small as compared with suspension cable since it is not directly added to the weight of carriage and counter weight. It is useful for lifting control of carriage 5, because there is no slide (slippage) between lower wheels 3 and lower hauling cable 7 since there is used a chain and a toothed wheel. Consequently, suspension cable 4, which is arranged in a series with lower hauling cable, benefits from this merit and slippage between suspension cable 4 and upper wheel can be prevented as well.

5. DRIVING UNIT

The driving unit is applying a lifting force to suspension cable 4 via the lower hauling cable 7 and is located at the bottom of the elevator hall. The term "bottom of the elevator hall" means that the driving unit is able to drive the lower hauling cable in the elevator hall 1, but it does not have to be restricted to the bottom of the hall but can be provided at any suitable position in the bottom portion of the hall.

The driving unit is basically constructed with a toothed wheel contacted with the hauling cable 7 for which preferably a chain is used, and an electric motor for driving this toothed wheel. A rotational force (the haulage) from the torque of the toothed wheels receiving the driving force of the electric motor is thus applied to the hauling cable. Component elements of the driving unit 8 may be adopted depending on the usage of the elevation system. If desired, means for mechanically changing revolutions (transmission means or a gear box) electrical control means and a braking system operating in emergency can be included.

Previously the bottom space of the elevator hall has not been used at all. Even if it had been utilized, it only has been filled with damping materials to absorb a shock which is caused by falling material. Location of the driving unit at the bottom of the elevator hall 1 like in this embodiment not only allows effective usage of the bottom space in the elevator hall but also facilitates reduction (absorption) of vibrations from the driving unit by directly introducing vibrations into the ground or basement so that it has a merit on the design of strength of the building as compared with a driving unit arranged on the top of the building.

FUNCTION

The function of the elevation system will be described as follows.

1. IN STATIC

Fig. 1 shows a driving unit 8 which is not running; in static, the weight of carriage 5 suspended from suspension cable 4 ist balanced with counter weight 6. As a whole, balance is kept between left and right weights of the suspension cable so as to compensate the different weight between left and right sides of suspension cable by itself. The compensation of weight by suspension cable will be described later.

2. IN MOVING DOWN

Fig. 2 shows a schematic drawing of the situation in which the carriage is moving down. When driving unit 8 turns in the clockwise direction, the left half side (as seen in figure 2) of lower hauling cable is subjected to a pulling force to pull down carriage 5. With moving down of the carriage 5, suspension cable 4 is moving to the left half side (as seen in the figure) and counter weight 6 and the right half side of lower hauling cable 7 being pulled up. At the same time carriage 5 moves down and counter weight 6 moves up accompanied with this motion.

Now there will be considered the balance of the weight in the elevation system at this time. When considering only suspension cable 4, while the self weight W1 of suspension cable 4 attached to carriage 5 is increasing with down-movement of the carriage 5, the self weight W2 of suspension cable 4 attached to counter weight 6 is decreasing and there will be generated the weight difference (W1-W2). However, the self weight W2 of suspension cable 4 will be compensated by increasing the self weight W4 of lower hauling cable 7 attached to counter weight 6, while the self weight W1 of suspension cable 4 attached to carriage 5 is increasing. Also the self weight W3 of lower hauling cable 7 attached to carriage 5 is decreasing with its down movement.

From the above description, it will be apparent that the total weight of each suspension cable portion respectively attached to carriage 5 and counter weight 6, and of the lower hauling cable 7 is approximately balanced between left and right sides as a whole.

Thus the weight of the section W1 of the suspension cable 4 attached to the carriage 5 added to the weight of the section E3 of the lower hauling cable 7 is set to be approximately equal to the weight of the section W2 of the suspension cable 4 attached to the counter weight 6 added to the weight of the section W4 of the lower hauling cable 7.

3. IN MOVING UP

Fig. 3 shows a schematic drawing in moving up carriage 5. Lower hauling cable 7 pulls down counter weight 6 when driving unit 8 is turning in the counter-clockwise direction. Carriage 5 is pulled up as a result of the suspension cable 4 being pulled by counter weight 6. Lower hauling cable 7 attached to carriage 5 is pulled up with moving up of the carriage 5. The description of the principal of controlling balance of weights between left and right sides will be ommitted since it is the same as above described in connection with moving down carriage 5.

Although the system is described above in case of constant weight of carriage 5, there is no problem to balance the different weight of suspension cable portions by the lower hauling cable 7, so that a changed weight of the carriage 5 will require only an action of setting the weight of counter weight 6 in the usual manner. The weight 6 of carriage 5 may be changed in accordance with the load placed thereon.

4. DRIVING UNIT

In the following the influence of inertia force on the driving unit and the required driving power for the carriage in moving up and down with the movement of the carriage will be considered.

First the influence of inertia force on driving unit 8 will be considered.

Concerning the conventional elevation system as shown in Fig. 5, for example, the more the weight of the suspension cable (b) attached to carriage (c) upon moving down of the carriage increases the more also the inertia force acting on the driving unit (e) at stoppage increases. On the contrary, according to the system of the invention, an inertia force acting on the driving unit 8 is small compared to the system of Fig. 5, due to keeping balance of weight between left side and right sides in moving up and down of carriage 5 and counter weight 6.

In consideration of the required driving force in moving up and down the carriage, in the conventional driving unit as shown in Fig. 5 it is required to determine the driving force taking into account the weight of the carriage (c) and of the suspension cable (b).

On the contrary, according to the invention, the carriage 5 can be moved up and down with a small driving force, taking into account only the weight of the carriage for determining driving force for moving up and down the carriage 5, thus being able to neglect the weight of suspension cable 4 which is compensated by the lower hauling cable 7 which constantly keeps balanced weight of suspension cable between left and right sides regardless of the elevation position of carriage 5.

It will be also considered to apply tension force on suspension cable 4 with over hanged weight while suspension cable 4 is given tension force in using hanged weight in the above described embodiment. As a method to apply a tension force, it is possible, for example, to apply such tension force by means of a jack to which an end of the endlessly jointed suspension cable 4 and/or an end of lower hauling cable 7 is fixed. In present example, it has an advantage to obtain a high efficiency in preventing slippage between suspension cable 4

and upper wheel 2.

Fig. 4 shows an embodiment of the elevation system of the invention applied to a vehicle parking tower.

The parking tower has a number of floors or parking areas and a plurality of parking spaces. The elevation system is arranged to be freely liftable within a passage 9 (corresponding to the elevator hall) facing each of these parking areas.

Carriage 5 comprises: an elevating rack 51 arranged along a long side of passage 9; a cross rack 52 movably carried on the rack 51 in the transverse direction of the passage 9; and, a catcher 53 carried on the cross rack 52 for free movement into and out from each parking space 10. Sequential up and down movement of the elevating rack 51, running in the left and the right directions of cross rack 52, and running forward and backward of catcher 53 makes it possible to transport a vehicle between a delivering point and a destination parking area.

The detailed description of the structure of the carriage will be omitted. It is therefore referred to the description thereof in the prior application with the publication number 90-279880 filed by the applicant.

The elevation system is provided at both sides of passage 9. At both sides suspension cables 4, preferably wire ropes, are trained around upper wheels 2. Beneath the passage 9, in which the elevating rack 51 and counter weight 6 are arranged respectively, both of lower hauling cables 7, preferably chains, extending between elevation rack 51 and counter weights 6, and the driving unit 8 (electric motor) and driving shafts are provided so that torque from the driving unit 8 can be applied to lower hauling cables 7, 7. In this case, elevation rack 51 is prevented from tilting to left or right, therefore, driving shafts 11 can be driven to be latched to both lower hauling cables 7, 7 at the same time.

When applying this system to an automobile parking, the merits of extremely low noises can be realized by using wire rope for suspension cable 4. While there might be the problem of a slippage between upper wheels and suspension cable 4, this can be solved by using the chain for lower hauling cable 7. In this automobile parking vibrations can be prevented to a great extent as compared with the conventional type, therefore, vibration from driving unit 8 can directly propagate to the ground without being intermediated with structures of the building.

In a still further embodiment of the elevation system according to the invention a chain can be used for suspension cable 4 similar to the chain arrangement used for the lower hauling cable 7.

Claims

1. An elevation system, comprising:

a carriage (5) liftably hanged in an elevator hall (9) and a counter weight (6) hanged at the opposite side of the carriage (5), characterized in that

a suspension cable (4) is provided around upper wheels (2) fixed in the elevator hall and the carriage (5) and the counter weight (6) are hanged at each end of said cable (4),

lower wheels (3) are located at the bottom of the elevator hall,

both ends of a lower hauling cable (7) provided around said lower wheels (3) are jointed to the carriage (5) and the counter weight (6), respectively, and one of suspension cable (4) or lower hauling cable (7) is jointed to a driving unit (8) for elevating the carriage (5).

2. An elevation system, comprising:

a carriage (5) liftably hanged in an elevator hall (9) and a counter weight (6) hanged at the opposite side of the carriage (5), characterized in that:

a suspension cable (4), preferably a wire rope is provided around upper wheels (2),

the carriage (5) and the counter weight (6) are hanged with a chain used as a lower hauling cable (7) and extending around lower wheels (3) located in the elevator hall (9),

both ends of the said lower hauling cable (7) are jointed to the carriage (5) and the counter weight (6), respectively,

a driving unit (8) for applying a lifting force to the carriage (5) via the lower hauling cable (7) is located at the bottom of the elevator hall (9).

3. An elevation system, comprising:

a carriage (5) liftably hanged in an elevator hall (9) and a counter weight (6) hanged on the opposite side of the carriage (5), characterised in that:

a suspension cable (4) is provided around upper wheels (2) located in the elevator hall (9),

the carriage (5) and the counter weight (6) are hanged at each end of said suspension cable (4),

a lower hauling cable (7) is provided around lower wheels (3) located in the elevator hall (9),

both ends of the said lower hauling cable (7) are jointed to carriage (5) and counter weight (6), respectively,

a driving unit (8) for applying a lifting force to the carriage (5) via the lower hauling cable

(7) is located at the bottom of the elevator hall (9), and for said suspension cable (4) and said lower hauling cable (7) are used chains.

4. An elevation system, comprising:

a carriage (5) liftably hanged in an elevator hall (9) facing a parking space in a parking tower, and counter weights (6) hanged on the opposite side of the carriage (6), characterised in that:

suspension cables (4), preferably wire ropes, are provided around upper wheels (2) located on both sides of the elevator hall (9),

the carriage (5) and counter weights (6) are fixed to each end of said suspension cables (4),

lower hauling cables (7), preferably chains, are provided around lower wheels (3) located on both sides of the elevator hall (9),

both ends of said lower hauling cables (7) are respectively jointed to both ends of the carriage (5) and the counter weights (6),

a driving unit (8) for rotatably driving both lower hauling cables (7) is provided at the bottom portion of the elevator hall (9).

Fig. 1

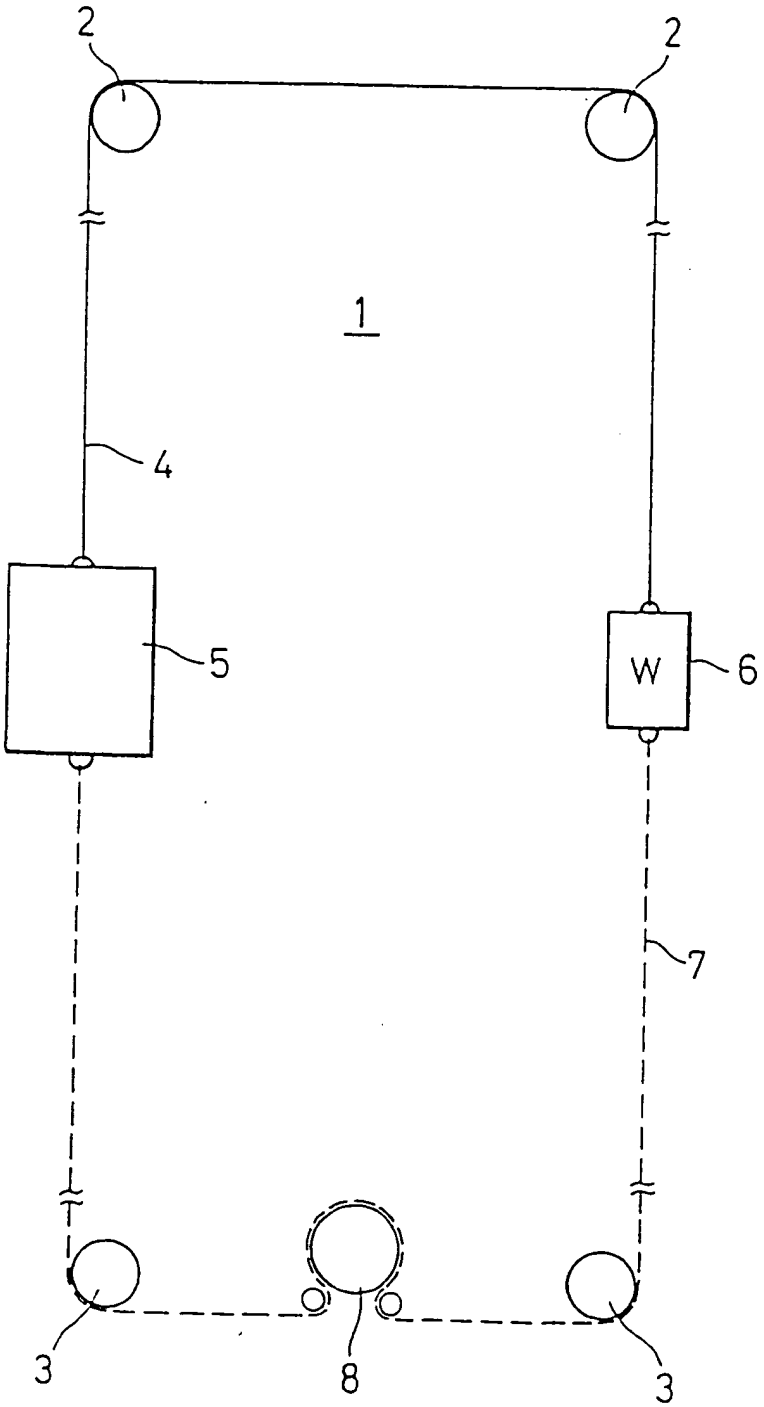


Fig. 2

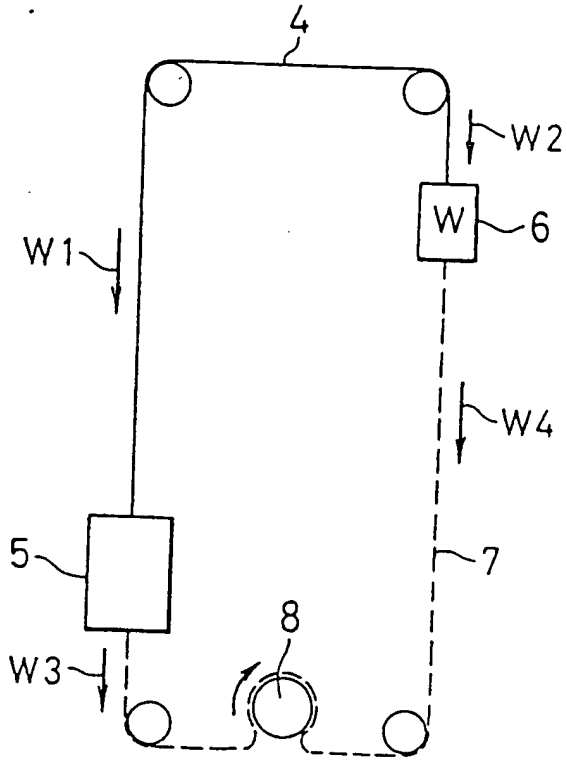


Fig. 3

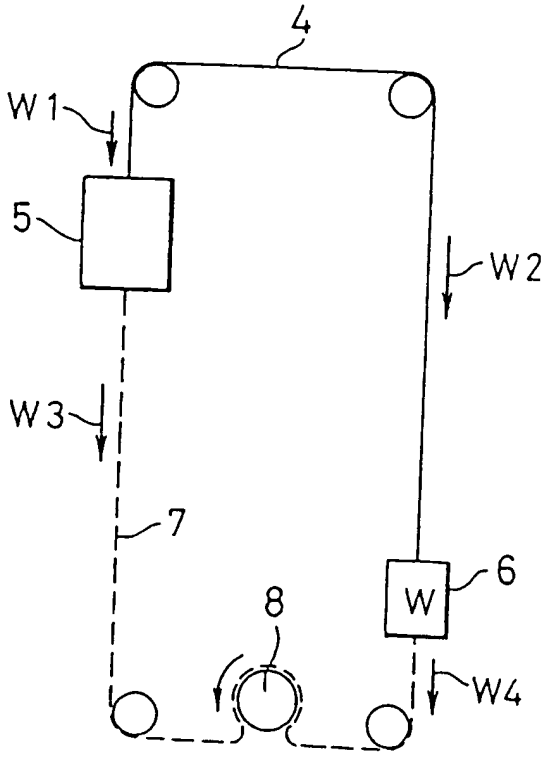


Fig. 4

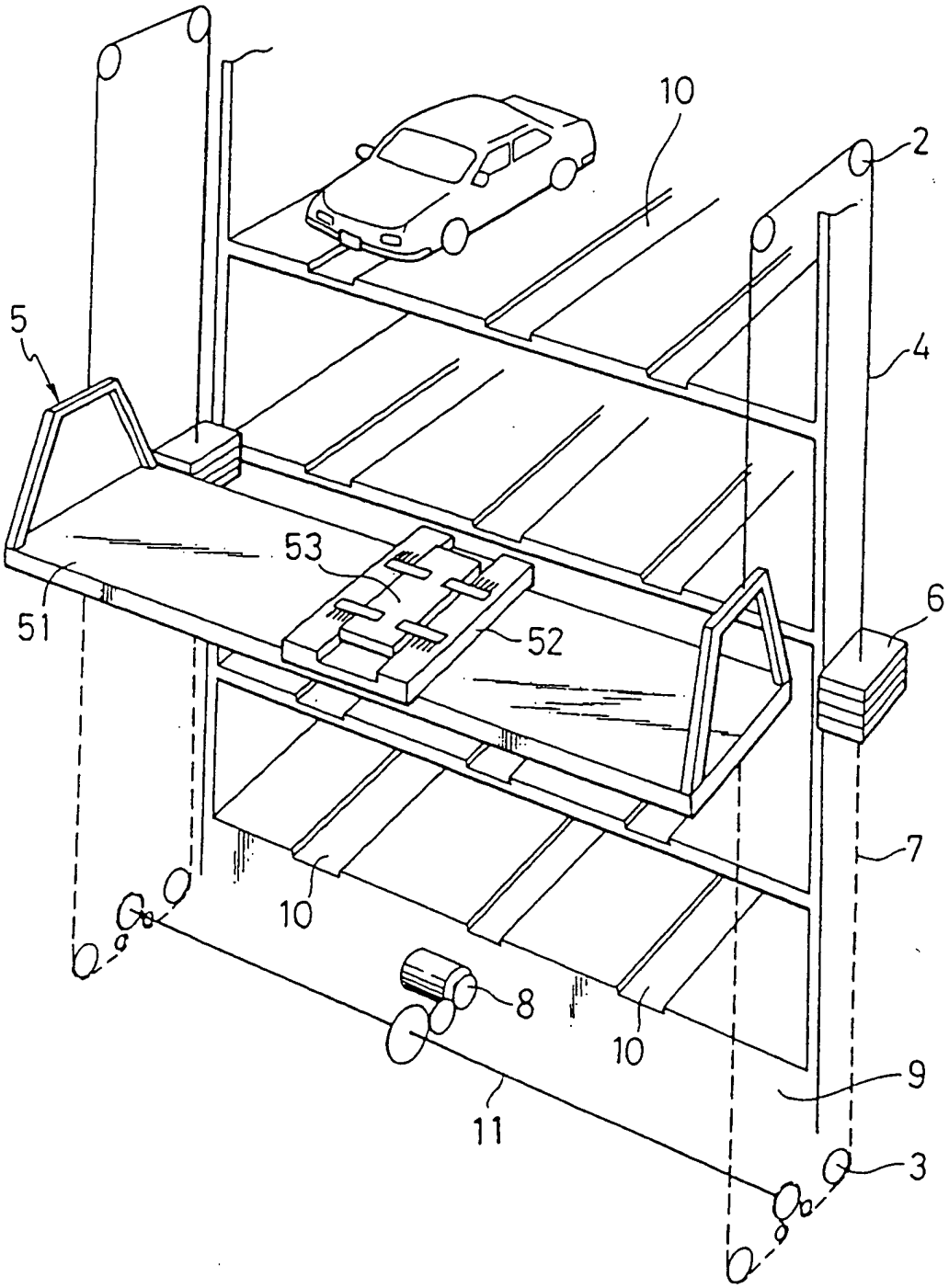


Fig. 5